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Making Maps

To make a map of a packet network, you need three things at a minimum:

- Linking: A knowledge of which nodes are linked to which
- Location: A knowledge of where the nodes are located
- Drawing: A map you can "draw" on

Lets deal with each of these. We will put what to draw upon until last because, in some ways, it is the most difficult.

1. **Node Linking** descibes which nodes have a "first hand" connection to the observed node. This is not the same as a node's "node list " the node list is a listing of all nodes "known " to the node, whether an immediate neighbor or not. Some, if not most, of the entries on that list are "neighbors-of-neighbors ". So, how do you find out what the real links are?

   The secret to finding the real links is in the "route list ". What this list looks like depends on the style of node providing it. Lets look at an example to see what it contains. To see a more complete description of a variety of node types, check the Node Reference

   In the following, the "`typewriter text`" is text that is input or output of a TNC. Text that is colored Red is text that is written TO the TNC. The character "C/R" represents an end-of-line generated by pressing the "return" key on a Macintosh keyboard or the "enter"

key on a PC keyboard.

A G8BPQ node are fairly common in many parts of the country. Here is what the route list looks like from a G8BPQ node. It is obtained by sending a simple "R" to the node after connecting to it.

```
R<C/R>
WSALEM:N7IFJ-6} Routes:
  1 W7OSU-1 192 1
> 3 N7IFJ-5 224 79
  1 KA7UPD-1 192 78
  1 N7PDX-3 192 16
```

If we look at the contents of this response from the node, it can be seen that there is one line for every neighbor in direct radio contact with this node. This particular node type tells us only the callsign of the node; others give the node name, or both the call and the name. In this case, their are four immediate neighbors.

Just to the right of each call, there is a number. This number can vary from 1 to 255. It is the "quality" of the link; the bigger the number, the higher the quality. Three of the neighbors have a quality of 192 and one has a quality of 224. The quality is set by the person who tends the node. Usually, there is a default quality that is assigned to any node heard from; in this case, it is probably 192. If appropriate, the quality can be set differently on a node-by-node basis; this was likely done for the N7IFJ-5 neighbor and we will see the probable reason in a bit.

The last number tells how large the node list is for each of the neighbors. For example, W7OSU-1 only has one node listed in its node list while KA7UPD-1 has 79.

Lets go back to the beginning of each line. Immediately ahead of each node call is a number. For this node, those numbers are "1" and "3". Generally, this number tells which "port" the connection is on. There is a big difference how this is denoted in different node types.

In G8BPQ nodes, one node can connect to several radios. Each radio is a "port" and they are numbered. We can tell which is which by sending a "P" (again, no quotes and followed by a carriage return) to the node to request the ports-list. Here is the list from that node:

```
P<C/R>

WSALEM:N7IFJ-6} Ports:
  1 144.970 (1200)
  2 70cm North (9600)
  3 70cm South (9600)
```

Now, we can see that all of the 192-quality links are on 144.970MHz while the 224-quality link is on a 9600-baud backbone.

Finally, one entry in the route list begins with a ".>". This simply indicates that that link is in use

Oh, how do you find out the node type in order to know how to interpret these list? Send a "U". (for Users) to the node. In this case it returns:

```
U<C/R>
WSALEM:N7IFJ-6} G8BPQ Packet Switch V4.07a :
Uplink 1(KA7EHK)
```

The identification of the node software should be quite clear.

2. **The Link List** comes next. In the area you want to map, you simply need to make a list of what is connected to what. I just make a text document with copies of the pertinent route lists. Here is a set of four that will be used in later steps of this tutorial.

```
BIGCTY:W3ABC-5} Routes:
  2 LOHILL 192 23
> 3 HIMTN  224 79

HIMTN:N3XYZ-7} Routes:
> 2 BIGCTY 224 17
```

```
  4 LOHILL 192 78
  4 PODUNK 192 16
  3 FARWAY 140 37

LOHILL:K3PKT-9} Routes:
  2 BIGCTY 192 17
> 3 HIMTN 224 79
  1 PODUNK 192 78

PODUNK:N2ZZZ-15} Routes:
  2 LOHILL 104 23
> 3 HIMTN  224 79
  2 BIGCTY  85  1
```

Here, we confronted with several of the issues faced by any route mapper. One is that PODUNK hears BIGCTY, but BIGCTY does not hear PODUNK. It should not happen, but it does. Is there a route there? I feel this one is fairly easy - no! Even if BIGCTY were to sometimes hear PODUNK, its is not a reliable route and should not be counted.

There are several other questions also hidden in this list. PODUNK gives the route to LOHILL a quality of 104 but LOHILL gives it a 192. Should this be a concern? I would say no. Often, node operators will set a route quality artificially low to prevent auto-routed traffic from passing through that node. In this case, 104 is not terribly low, anyway. So, I would not be concerned.

But, what if you found a route with a really low quality. Perhaps it has been given a 25 or even a 10. Do you include such a route with a really low quality? I probably would, using some notation (dashed line, for example, on a map) to indicate its uncertainty. Again, however, it might just be set artificially low to discourage network routing.

Now, however, we have all of the linking information to consider drawing a map. But, one more piece of information is needed. Where is each of these nodes located?

3. **Node Location** can be a real puzzle. You may have to

look all sorts of places to find out. The one consolation is that you usually DO NOT need to know precise location. If you are doing mapping for the purpose of planning new network equipment and want to determine whether or not a given route might be good, then more precision might be warranted. For general information mapping, however, don't get too concerned about precision!

One of the places to start is simply the name of the node. If you are very familiar with the area AND the names relate to well defined geographical locations, then the name might be enough.

But, maybe Bigcity really is BIG (think about Los Angeles as an example). Then the name is not enough. How do you find out more? Try the INFO response for the node as the next step. Perhaps, this is how BIGCTY responds:

```
BIGCTY:W3ABC-5} W3ABC BIGCTY Packet Switch
Sponsored by Bigcity ARC.
```

Well, that is pretty specific. Now, you only need to know where Water Tower 17 is!

Lets consider another case. Maybe there is no Lohill that you know about. You might try the gazateer at TopoZone. It references EVERY name on every USGS topographic map. This won't help you in other countries but many other countries also have their own gazateer sources.

Sometimes, you won't find the name in a gazateer, even after you try variants such as "Low Hill" or "Lows Hill". What do you do then? Ask questions. Look up the call sign of the node operator and see if there is a name in that vicinity. Check with the node op directly. All of those things can work.

Hopefully, we now know the locations of all of the pertinent nodes in the network. Next, its time to draw

the map.

4. **Drawing The Map** depends, very strongly on the form you want. Do you want electronic distribution or do you want a big paper map? You might want a paper map, for example, to put down on a table for planning purposes. Or, maybe, you just want a map to distribute to other hams.

   If you want a paper map, then you have some choices. In the United States, nice USGS maps of each state are available; the state map for Oregon is, for example, about 36" X 48". But, if cost is an issue, find a pilot. Aeronautical charts have a good scale, not too much clutter (away from major airports), and have to be replaced periodically.

   For electronic maps, I prefer several sources. APRS maps are available for all US States. The "radiomaps" groups in Yahoo have similar maps (particularly supporting "uiView" software) from all over the world; you may have to "register" but it costs nothing and the burden is minimal. These maps are generally "gif" images and can be edited with a wide variety of programs.

   Another source I really like for the U.S. is the set of state maps produced by Johns Hopkins University. They are part of the "Color Landform Atlas of the United States" and are available at http://fermi.jhuapl.edu/states/states.html. Choosing a county map from the selection for any state will get you a map of the entire state, with shaded elevations and county outlines. These maps do not show cities, highways, etc, but the county outlines help to establish locations fairly closely. You can easily locate things within a mile or less on these maps. They are jpeg images and can be easily edited

   If, however, you simply wish to show how things are connected and the precise locations are not an issue, then simply put symbols on a blank worksheet. It really

works quite well, as will be shown in the next part.

5. **Drawing A Map** isn't difficult at all. Lets start by drawing one for our mythical four nodes that created the route lists shown earlier. I start with a simple symbol to represent the node, itself. For me, a circle makes sense. I add a rectangle next to the circle (actually, with the circle overlapping one end slightly and "on top"); the rectangle makes a nice place to put the name of the node. The drawing, to the right, shows this step.

   If your drawing software allows it, Group the circle and the rectangle. Then, just make as many copies as you have nodes. Add text to each one, then group the text with each symbol so they stay together as you move them. Once the symbols are in their correct places, add lines to represent the links. I try to be careful that the symbols remain on top of the end of the lines to make a cleaner appearance. When there is a link to a location off-map, I just use a line with an arrow-head on it, and label where the link is going.

   This step shows the map with the links added, as specified by the previous set of route lists. This is a fine map. It shows all of the links. But, there is a lot more that can be shown, for relatively little effort. And, it will markedly improve the usefulness of the map.

   What is missing is any sense that the links are actually on different frequencies. Why is this important? One of the major things this shows is where hidden transmitter problems are likely to occur. It also gives users, and others, a sense of which links are capable of higher through-put because they lack competition. And, its immensely useful for planning.

   I try to use two methods to indicate different frequencies. Color works very well. But, if the map is ever going to be printed, you should take into account the fact that many computer owners do not have color printers. So, I change the width of the line to at least

indicate which band the link is on; I use narrow for the lowest band (usually 2 meters) and progressively wider lines for higher frequencies. Take a look at what the map looks like once this simple change has been added.

Now, suddenly, things become much clearer. If I were a BBS operator in BIGCTY forwarding traffic to an BBS in PODUNK, I would NOT rely on network autorouting. I would script the BBS to connect to HIMTN first, then to PODUNK. This would make use of dedicated backbones with no hidden stations. Of course, the route qualities OUGHT to be set to make exactly this happen, but you cannot count on it. And, if I were a user, I would try to do the same thing!

Further, this map shows something that is probably quite apparent to opertors who use PODUNK and BIGCTY. They have a big hidden station problem! These nodes, and LOHILL all link on the same frequency and users probably use that frequency also. BIGCITY users won''t hear users in PODUNK, or visa versa. There are probably LOHILL users who don't hear users at either BIGCTY or PODUNK. This map now shows the problem quite clearly. Now, its time to figure out how to improve it!

Now, you know HOW to do it. Go, do it, and have fun!

Comments